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(54) FIRE RETARDANT TREATMENT FOR FOAMS

(71) We, HAIRLOK LIMITED, of 24 Portland Place, London, W1N 3DF, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the improvement of the resistance of flexible polymer foams to ignition and spread of flame.

Cellular materials such as flexible polyurethane and rubber latex foams are fairly easily ignitable, with a fast spread of flame once ignited.

Such materials may be made less easily ignitable by incorporation, prior to foaming, of flame retardant additives such as halogen compounds, antimony oxide and phosphorus compounds. The degree of protection is limited, however, by the amount of such additives that can be tolerated by the cellular product without impairing its physical properties. Materials treated in this manner have been able to meet the requirements of the less demanding ignitability tests such as ASTM D1692, FMVSS 302 which expose small samples to small sources of ignition at comparatively low ambient temperatures, but do not meet more demanding tests.

Another method of imparting resistance to ignition, in polyurethane foams, has been to encourage the material to melt away from the source of ignition. Such an approach has been described in BP. 1,395,633. The method, at least when materials giving a wick effect are not present, has also enabled foams to meet the requirements of small scale ignition tests.

We have found that by treating the surface of polymer foams, to a depth of up to half an inch, with a particular coating, a substantial improvement in resistance to ignition and flame spread is obtained. Moreover, because the treatment is restricted to the surface, its effect on the physical nature of the cellular material as a whole is limited. It has been found necessary to base the coating formulation on a flexible binder, as this has less of a stiffening effect on the surface, but heavy loadings, that would be unacceptable if present throughout the bulk of the material, can be used.

The invention accordingly provides a body of flexible open cell polymer foam, the foam structure carrying at one or more surfaces of the body, but not throughout, a flame retardant flexible coating, which coating i) comprises a polymeric binder that is inherently fire-retardant or contains one or more flame-spread inhibiting additives ii) is present in the foam structure to a depth of up to half an inch as a coating thereon but retains the open cell structure of the foam, and iii) chars on heating to form a protective carbonaceous layer in which the cell structure is preserved.

The pick up of the coating may for example be from 0.5 to 1.0, 2.0, 3.0, 4.0 or 5.0 ounces/square foot dry on dry.

Differently expressed, the pick up by weight, coating to polymer dry on dry, may be from 0.5:1 to 30:1 according to the degree of protection required and the physical properties acceptable in the surface layer. The pick up is preferably not less than 1 or 1.5:1, advantageously not less than 5:1, and preferably not more than 25 or 20:1, advantageously not more than 15:1.

It has been found that the char formed when the surface of such foam is exposed to a source of heat or flame, is a very effective heat insulator and is able to withstand high temperatures, even red heat. Thus the cellular material behind the char barrier is protected. Moreover, we have found that when, under extreme conditions of temperature, the material behind the char barrier does decompose, the gases emerge through the cellular char layer but cannot readily transfer ignition back to the material inside. This is thought to be similar to the "Davy Lamp" principle where a flame cannot pass through a fine gauze.

The nature of the coating, applied by spray, roller or other convenient means, is that it coats the internal cell walls of the foam, the skinned effect given by compositions that web on application being avoided. The depth that the coating extends into the foam can readily be controlled and is normally arranged to be from 1/16" to ¼" deep and thus present to

a depth at least equal to the larger cells of the foam and preferably e.g. 2 to 5 cells deep. The coating, being porous, enables the cellular material to "breath", important in the case of flexible materials to be subjected to compression in use.

The coatings are preferably based on a polymer that is inherently flame retardant, tending to char rather than burn away. Suitable materials are, for example, halogen-containing polymers such as polychloroprene rubber, plasticised polyvinyl chloride and plasticised polyvinylidene chloride. Other non-flame retardant polymers may however be used, with the addition of flame retardant additives. Examples of these polymers are styrene-butadiene rubber and polyacrylates. All the polymers may be used in latex form or as a dry material dissolved in a suitable organic solvent, though latex is normally more convenient.

It has been found advantageous, even where charrable, inherently flame retardant polymers are used, to reduce flame spread by adding flame retardant chemicals such as halogen containing compounds, antimony oxide or hydrated alumina. Hydrated alumina has been found to be particularly useful as it releases only non-toxic combined or crystallisation water on heating and leaves an inert residue which contributes to the char layer.

The level of additives used will depend on the inherent fire retardance of the binder, and the protection required of the final coating, and is selected to give, at the coating pick-ups used, the required charring properties. Suitable amounts are readily found by test, for example 0.5 to 5.0 ounces/square foot. Preferred amounts of alumina are 50 to 600, preferably 50 to 300, parts per 100 parts dry weight of polymer binder.

Example 1

A spray formulation was made up as follows, the ingredients being added to the latex in the order indicated, whilst stirring.

	Wet Wt.	Dry Wt.
1. Neoprene latex 601A	166	100
2. Aquarex WAQ anionic stabiliser, 25%	2	0.5
3. Titanium dioxide pigment dispersion	20	10
4. Antioxidant 2246	1	1
5. Baco FRF 40 hydrated alumina	200	200
	389	311.5

The latex is a polychloroprene rubber latex sold by DuPont the source also of the stabiliser. Baco FRF40 is sold by the British Aluminium Co. Ltd.

This formulation was sprayed onto the surface of a conventional flexible poly-ether polyurethane foam sample size 12″×12″×2″ thick, of density 25 Kg/m³, using a hand held air-spray gun. A coating weight of 2½ ounces per square foot was obtained. It was noted that the coating extended into the foam to a depth of about 1/16″ of an inch. The coating was allowed to dry at room temperature for 24 hours.

The coated sample was placed on a tripod and subjected from below to a bunsen burner flame. Under this treatment the coating charred, but no flaming occurred. Even when the surface was heated until it glowed red, no ignition occurred.

Examination of the sample interior after the test showed that the foam had decomposed behind the charred foam layer, but because of the protection afforded by this layer, flaming ignition did not develop.

Example 2

The same spray compound as Example 1 was used. This was applied by the same method as Example 1 to a 12″×3¾″×1″ sample of flexible poly-ether urethane foam that had incorporated in it conventional flame-retardants. This type of foam had been found previously to show over 200 mm spread of flame on small sample tests by BS. 476, part 7. A coating weight of 2.5 ounces per sq. ft. was applied by spray and was observed to extend into the foam by about 1/16 of an inch. The coating was allowed to dry at room temperature for 24 hours. The surface of the coated sample was noted to have comparable air permeability to the original uncoated foam.

The coated sample was tested to the preliminary test described in BS 476, part 7 and found to give a spread of flame of 60 mm.

As in the case of example 1, it was noted that the protective char layer had a similar cellular structure to that of the original foam.

Example 3

The spray formulation used in Examples 1 and 2 was applied in a similar manner to a 12″×12″×4″ sample of conventional pin-core rubber latex foam. A coating weight of 2.5 ounces per sq. ft. was used. The coating was allowed to dry at room temperature for 24 hours.

A lighted match was placed on the surface of the coated sample. The match caused minor charring to the coating in the immediate area of contact, but no ignition.

A lighted match placed on an uncoated sample quickly ignited the foam, which then burned fiercely.

Example 4

A coating formulation was formulated as detailed below, adding the ingredients to the latex, with stirring, in the order given:

	Wet Wt.	Dry Wt.
Intex (Registered Trade Mark) 131 latex	154	100
Sulphur dispersion	4	2.5
Antimony oxide dispersion	12	8
Pentabromotoluene dispersion	24	16
Zinc diethyldithiocarbamate dispersion as accelerator	1.5	1
Zinc mercapto benzothiazole dispersion as accelerator	1.5	1
Antioxidant 2246 (Anchor Chemicals Ltd.)	1	1
Zinc oxide dispersion	8	5
Baco FRF 40 hydrated alumina	150	150
	356	284.5

The latex is a styrene-butadiene latex sold by International Synthetic Rubber Ltd.

The formulation was applied by means of a doctor blade onto the surface of a 12"×12"×1" sample of flexible polyurethane foam of density 18 Kg/m³. By controlling the pressure of the blade and the quantity of compound applied, it was possible to induce the coating to penetrate to a depth of ¼ of an inch.

The sample coated in this manner and having a coating weight of 2½ oz. per sq. ft. was dried in an oven at 100°C for 1 hour. It was removed and conditioned at room temperature for 24 hours.

The coated sample was subjected to radiant heat from a 2 Kw electric fire and simultaneously to the flame of a bunsen burner. The surface charred over but no spread of flame occurred across the surface.

Note: The foam treated in Example 2 was a flexible polyether urethane, density 30 kg/m³ containing 10% 'Flammex' T23P—tris (2,3-dibromopropyl) phosphate ex. Berk Chemicals Ltd.

WHAT WE CLAIM IS:—

1. A body of flexible open cell polymer foam, the foam structure carrying at one or more surfaces of the body, but not throughout, a flame retardant flexible coating, which coating i) comprises a polymeric binder that is inherently fire-retardant or contains one or more flame spread inhibiting additives ii) is present in the foam structure to a depth of up to half an inch as a coating thereon but retains the open cell structure of the foam, and iii) chars on heating to form a protective carbonaceous layer in which the cell structure is preserved.

2. A foam according to claim 1 in which the polymeric binder comprises an inherently flame-retardant, halogen-containing polymer.

3. A foam according to claim 2, in which the binder comprises also a flame-spread inhibiting additive.

4. A foam according to any preceding claim, in which an inorganic fire-retardant additive taking part in the formation of the char is present in the coating.

5. A foam according to claim 4, in which the inorganic additive is hydrated alumina.

6. A polyurethane foam, according to any preceding claim.

7. A foam according to any preceding claim, in which the coating is 1/16" to ¼" deep.

8. A foam according to any preceding claim, in which the coating pick up is 0.5 to 5.0 ounces per square foot, dry on dry in the coated depth.

9. A foam according to any one of claims 1 to 7, in which the pick up by weight, coating to polymer dry on dry, is from 0.5:1 to 30:1 in the coated depth.

10. A foam according to claim 9, in which the pick up is not less than 1:1.

11. A foam according to claim 10, in which the pick up is not less than 1.5:1.

12. A foam according to claim 10 or 11, in which the pick up is not more than 25:1.

13. A foam according to claim 12, in which the pick up is not more than 20:1.

14. A foam according to claim 9, in which the pick up is from 5:1 to 15:1.

15. A foam according to any preceding claim, containing as flame-spread inhibiting additive 50 to 600 parts hydrated alumina to 100 parts binder, by weight dry on dry.

16. A foam according to claim 15, in which the hydrated alumina content is 50 to 300 parts.

17. A flexible open cell polymer foam having a flame-retardant flexible surface coating, substantially as herein described in any one of the Examples.

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